SCIENCE

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BEVERAGES.

ALL beverages contain water as their chief constituent, and they may be divided into two classes, alcoholic and non-alcoholic.

Alcoholic Beverages.

Alcohol is the product of the alcoholic fermentation of any saccharine material, and these materials may be arranged in three groups: first, grapes and other sweet fruits which contain fermentable sugar or glucose, the expressed juice of which at once enters into fermentation on exposure to air; second, substances which contain common or cane sugar, the first step in the process of fermentation being the formation of glucose by taking up the elements of water; and, third, the various kinds of grains, potatoes, and other substances containing starch, which by the action of a peculiar ferment, diastase, naturally, or by the action of dilute mineral acids artificially, is converted into glucose.

FERMENTATION.—In the manufacture of both malt and distilled liquors the object is to convert the starch of the grain employed, by suitable fermentation, into alcohol. In the one case a low percentage of alcohol is striven for, and in the other the maximum amount that is capable of being produced.

Chemically speaking, fermentation takes place wherever an organic compound undergoes changes of composition under the influence of a nitrogenous substance called a ferment, which acts in small quantities and yields nothing appreciable to the fermented substance. These ferments are living minute vegetable cells, and different varieties are found in the various fermentations with which we are familiar, viz., alcoholic, acetic, lactic, butyric, etc.

In normal alcoholic or spirituous fermentation we find the minute vegetable cells commonly called "yeast" growing and multiplying, assimilating the sugar or glucose found in the infusion or solution (whether the glucose is derived from the starch of the grain, by the action of another ferment called diastase, or artificially prepared), and excreting a large proportion in the form of carbonic acid and alcohol.

Theoretically 105.3 parts of glucose, corresponding to 100 parts of cane sugar, would produce about 51 parts of alcohol and 49 parts of carbonic acid, but as a matter of fact Pasteur and other investigators have found that there were small quantities of other products present, so that the theoretical yield is not obtained.

Under the general name of ferment or yeast a large number of varieties and species are included, which resemble each other in form, but differ greatly in their properties and characters. The germs of these yeasts are everywhere floating in the air, especially in the hot summer months, and when they encounter a favorable soil for their development they grow and multiply like other plants under similar conditions; for instance, when they attach themselves to the stems and skins of fruit, they give rise to the "spontaneous" fermentation of grapes, apples, pears, etc.

In addition to the yeast germs, the air of any locality contains numerous living organisms, the mould, bacteria, and other micro fungi, for the most part injurious to the making of the wort or wine, and forming the true ferments of disease.

Among all these ferments several species will set up alcoholic fermentation in the wort or grape juice, and transform it into alcohol and carbonic acid, but all of them will not give a good product. On the contrary, the great majority of these spontaneous yeasts would have disastrous effects, for the brewer especially, decomposing the beer to such an extent as to render it unsalable.

The species called *Saccharomyces cerevisiæ* constitutes the large class of beer-yeast proper, and the one the best known and studied. Two varieties of *Saccharomyces cerevisiæ* are extensively cultivated, the high or upper (*obergährung, fermentation haute*), and the inferior or lower (*untergährung, fermentation basse*). The former is used with a high, 15° to 18° C. (59° to 65° Fahr.), temperature, the yeast and impurities rising to the top of the vat, whence they are removed by skimming; and the latter at a low temperature, between 4° and 10° C. (39° to 50° Fahr.), where the fermentation takes place slowly and the yeast settles at the bottom in a compact mass. Each variety will produce its own peculiar and characteristic fermentation. A mixture of either of these varieties with one or several other species of *Saccharomyces*, as *S. ellipsoidens*, *mycoderma*, etc.; results in disaster to the wort.

The wort and grape juice naturally present a proper soil for these harmful as well as for the proper or true ferments, and it is not surprising that the germs of the noxious flourish and develop to the detriment of the true yeast plant.

These yeast plants and germs are so minute as to require the use of a microscope with high-power objectives to discern and differentiate them. Like all other fungi, they are capable of distinct cultivation; and with the exercise of some care, and the assistance of a trained observer, a brewer, distiller, or wine manufacturer, after some experiments, could maintain a crop of such particular yeast plant as yields the best results and gives a uniform product.

This method of "pure" cultivation has been extensively

employed in breweries in Denmark, Germany, and elsewhere in Europe, and there is no scientific reason why the same system should not be carried on in this country to the great improvement of our beers and wines.

At the old Carlsberg brewery near Copenhagen, Professor Hansen has cultivated two varieties of bottom *S. cerevisiæ*, which give different results in practice. One gives a beer well adapted for bottling, and is chiefly employed for home use. The other gives a good draught beer, containing more carbonic acid than the former variety; it is not adapted for bottling, but is much preferred by German brewers, and is therefore chiefly cultivated for export.

Experiments upon an industrial scale are being carried on at Burton-on-Trent, in England, with different species of pure yeast. Several varieties of *S. cerevisiæ* have been separated from the yeast generally employed and cultivated, which, when used on a practical scale, give entirely different results, both as to flavor, brightening, attenuation, and mode of separation of the yeast. Experiments have also shown that these characteristics can be maintained unimpaired throughout a very great many successive fermentations in the brewery. Cultivations have been started from a single yeast cell, and with proper care have been maintained for a long time.

On a commercial scale the cultivation should be conducted in sufficiently large vessels to yield the necessary amount of yeast used for fermentation. For this purpose two vessels should be employed, one in which the wort or other sugar solution used for cultivation is sterilized by being boiled, then stirred and aerated, excess of pressure being prevented by means of air filtered through sterilized cotton; into the other (the fermenting vessel, previously sterilized by steam) the sterilized wort or sugar solution is forced, and pure yeast from the laboratory added. When the fermentation is at an end, the liquid is run off, the apparatus filled with wort or sugar solution, stirred, and very nearly emptied. The wort so obtained, and containing yeast, is then transferred to the brewing vessels; the residue in the apparatus, with the addition of sterilized wort, serves for the future production of yeast. Pure yeast can thus be continually obtained without fresh inoculation, as the small amount remaining in the fermenting vessel serves this purpose. These vessels are jacketed and provided with the necessary safety-valves, ventilators for admitting filtered air, exit tubes for the escape of steam and carbonic acid, thermometers and manometers for regulating temperature and pressure, and inlets and outlets for wort, beer, and yeast.

DISTILLATION.—The object of the distiller is to separate the alcohol contained in the fermented wort from the foreign matter with which it is associated. For this purpose he has resort to a still. The alcohol thus produced is not, as has been well known for some time, a single substance, homogeneous, always the same in its nature, form, and effects; on the contrary, it is an extremely variable body, of diverse chemical composition and physical characteristics; it is not *one* alcohol, but many, which chemists have divided into several series.

The distiller commonly divides the product of his still into three classes: (1) products with a bad taste, the heads; (2) alcohol, properly speaking; and (3) products with a bad taste, the tails. The first and third are kept separate from the middle, which is the most valuable portion. Table I., according to Dr. Rabuteau, gives the boiling points of these different products.

Table I.—Showing the Boiling Point of Different Products.

Products of Distillation.	Boils at—	
	Degrees C.	Degrees F.
Products with a bad taste, the heads:—		
Aldehyde	20.8	69.4
Acetic ether	72.7	162 9
Alcohol, grain spirits, ethyl alcohol	78.0	172.4
Products with a bad taste, the tails:—		
Propyl alcohol	97.0	206 6
Butyl alcohol	109.0	228.2
Amyl alcohol	132.0	269.6
Valerianic ether	133 0	271.4
Amyl acetate and other nameless products	136 0	276 8

Aldehyde is a colorless, easily mobile liquid, having a specific gravity of 0.8009 at 0° C. (Kopp). Its vapor density was found by Liebig to be 1.532, who also states, that, when inhaled in large quantities, the vapors, of a peculiar ethereal suffocating odor, produce a cramp, which for a few seconds takes away the power of respiration. (Isidore Pierre compares its action to that of sulphurous acid.) It is miscible with water in all proportions, heat being evolved, and it is likewise soluble in both alcohol and ether. The addition of water raises the boiling point of aldehyde. It absorbs oxygen, and is slowly converted into acetic acid.[1]

Ethyl acetate or acetic ether is a mobile liquid possessing a penetrating, refreshing smell and a pleasant burning taste. It has a specific gravity of 0.91046 at 0° C. (Kopp). Its vapor density was found by Boullay and Dumas to be 3.016. It mixes with alcohol, ether, acetic acid, etc., in all proportions, and dissolves a large number of resins, oils, and other organic bodies. Its action in many cases, when used as medicine, resembles that of common ether, but it possesses a more agreeable taste and smell. It is also used for addition to the poorer classes of wine, liquors, etc.[1] According to Professor Dujardin-Beaumetz, the toxic dose of aldehyde is from 1 to 1.25 grams, and that of acetic ether 4 grams, per kilogram of the weight of the animal.

Methyl alcohol is the lowest form of the alcohol series, and when pure is a colorless, mobile liquid, having a vinous smell closely resembling that of ethyl alcohol. It has a specific gravity of 0.8142 at 0° C. (32° F.) (Kopp). The boiling point, as stated by various observers, varies from 58.6° to 66.5° C. (137° to 152° F.), owing to the great difficulty of obtaining it in a perfectly anhydrous condition. The difference between the densities of mixtures of methyl alcohol and ethyl alcohol with the same proportions of water is so small that the tables ordinarily used for the latter may be employed for most purposes in ascertaining the strength of the former.

Methyl alcohol is miscible in all proportions with water, ethyl alcohol, and ether. In its solvent and chemical properties it closely resembles ethyl alcohol.

[1] Roscoe and Schorlemmer's Chemistry.

Wood naphtha, pyroxylic spirits, is the name given to the impure commercial methyl alcohol. It is a very complex liquid, containing variable proportions of methyl alcohol, acetone, methyl acetate and formate, allyl alcohol, aldehyde, water, etc. The best commercial wood naphtha contains about 95 per cent of methyl alcohol, the common varieties from 75 to 90 per cent, and sometimes going as low as 30 to 40 per cent. It has a very characteristic odor, and if taken internally will generally produce nausea and other deleterious effects. Pure methyl alcohol, however, is free from these objections. Cases may be cited from the English court reports and daily papers where persons habitually drank methylated alcohol without any other toxic effect than that common to ethyl alcohol.

The higher alcohols, propyl, etc., have a greater toxic effect than ethyl alcohol. Brockhaus has recently personally investigated the effects of propyl, butyl, and amyl alcohols on the system. He found the disagreeable symptoms, giddiness, nausea, etc., to increase with the molecular weights of the alcohols, and amyl alcohol itself proved to be a very violent poison. According to the experiments of Rabuteau, amyl alcohol is fifteen times as intense as ethyl alcohol, and is even fatal in small doses. Amyl alcohol is one of the chief constituents of fusel oil.

An addition of 10 per cent of wood naphtha to ethyl alcohol lowers the boiling point of the mixture 3.3° C. (6° F.) (Ure).

Ethyl alcohol, spirits of wine, ordinary or grain alcohol, is next to methyl alcohol in the ascending order of the alcohol series, is the alcohol on which the internal-revenue tax is levied, and is the alcohol with which most people are familiar. It is a limpid, colorless liquid, of a hot pungent taste, and has a peculiar pleasant smell. According to Mendelejeff, absolute alcohol boils under the normal pressure at 78.3° C. (173° F.), and has a specific gravity of 0.80625 at 0° C. (32° F.) compared with water at its maximum density, 4° C. Dr. E. R. Squibb, of Brooklyn, N. Y., in 1884 obtained alcohol of a specific gravity lower than that recorded by any previous observer, viz., 0.80257 at 4° C., or 0.80591 at 0° C. compared with water at its maximum density. Absolute alcohol, however, is comparatively unknown outside of chemists' laboratories. When we speak of alcohol, we generally mean the liquid that contains from 90 to 95 per cent by volume of absolute alcohol.

Ethyl alcohol is miscible with water in all proportions, a considerable evolution of heat and contraction in bulk taking place on admixture. It is nearly impossible to remove the last traces of water, owing to the tendency of alcohol to quickly absorb moisture from the air. It is a powerful solvent for fluid and solid bodies, both organic and inorganic. It absorbs many gases with considerable avidity. As found on the market, ethyl alcohol often contains traces of higher homologues, of aldehyde and acetic acid, of volatile oils, of various fixed impurities, both organic and inorganic, and is more or less fixed with water.

The tails or faints, as well as the still less volatile or ordinary fusel oil, are mixtures of several alcohols and fatty acid ethers, their relative quantities depending on the nature of the materials used in mashing, belonging to the higher series of alcohols, and consequently possessing greater toxic effects.

Propyl alcohol was discovered by Chancel in 1853 in small quantities in fusel oil obtained in the manufacture of wine-brandy. It resembles ethyl alcohol in its odor. It has a specific gravity of 0.8198 at 0° C., and boils, according to various observers, at from 96° to 98° C. The latter number is probably the correct one, as the boiling points of the normal alcohols increase 19.6° C. for every increment in composition of CH (Grimshaw and Schorlemmer). It is miscible in all proportions with water, but, on the addition of easily soluble salts, as calcium chloride, etc., it separates out from aqueous solutions. Propyl alcohol is not used in the arts or manufactures, but is chiefly employed in scientific research.[1] It is toxically more active than ethyl alcohol; the dose is from 3 to 4 grams per kilogram of the weight of the animal.

Butyl alcohol occurs in varying quantities in several fusel oils, and is especially found in the spirits from beet-root, potatoes, and grain. It was discovered by Wurtz in 1852. It is a somewhat mobile liquid, possessing a spirituous smell, but at the same time a fusel-oil odor, resembling that of syringa flowers. It boils at 108° to 109° C., and has a specific gravity of 0.817 at 0° C. At ordinary temperatures it dissolves in ten parts of water, and the greater part is separated from solution on the addition of easily soluble salts, chloride of calcium, common salt, etc. According to Rabuteau, it is toxically four times as active as ethyl alcohol, its dose being 2 grams per kilogram of the weight of the animal. It has a toxic action on the heart and blood, producing muscular trembling and in large doses convulsive spasms.

Amyl alcohol, so called by Cahours because it was chiefly found in spirits obtained from bodies containing starch (amylum), is commonly called potato spirits. It has been found since to occur in all fusel oils. Amyl alcohol was for a long time considered to be one distinct compound. Biot first drew attention to the fact that this body possesses the power of rotating the plane of polarized light to the left; and Pasteur, in 1855, pointed out that the rotary powers of different samples of amyl alcohol vary according to the source from which they are obtained. From this he concluded that the body termed amyl alcohol is a mixture in varying proportions of an optically active and an optically inactive compound. He succeeded in obtaining the two modifications of the alcohol, and experiments of later investigators have established that they do not possess an identical chemical constitution. Fermentation amyl alcohol is a colorless, highly refracting liquid, possessing a burning taste and a penetrating smell, boiling at 131° to 132° C., and solidifying at —21° C. Inhalation of its vapors produces difficulty of breathing, coughing, headache, and giddiness.[1] It kills rapidly, according to Dujardin-Beaumetz, in doses of from 1.59 to 1.75 grams per kilogram of the weight of the animal. Even in small doses it exerts a powerful effect, bringing about intoxication and coma, producing at first a violent excitement of the nerve centres, followed by depression of the sensitive and motive forces.

Valerianic ether is a colorless liquid, having an irritating taste, and an odor which has been compared to that of apples; it is met with in an extremely small proportion in fusel oils. The same is true in regard to amyl acetate, a colorless liquid of a peculiar and irritating taste, of an odor

[1] Roscoe and Schorlemmer's Chemistry.

that recalls that of pears. Both of these substances have been little studied by chemists.

In short, very complex in their compositions, which are still very imperfectly known, the spirits of commerce not only contain the ethyl, propyl, butyl, and amyl series of alcohol compounds, on which most research has been concentrated, but also a certain number of other products, as pyridin and several aldehydes of unknown composition.

Drs. Laborde and Magnan submitted a report to the French Academy of Medicine, Oct. 21, 1888, giving the results of their experiments with the higher alcohols and artificial bouquets,[1] in regard to their toxic effects on animals, comparing the effects of the natural products with those of the artificial products.

All spirits consist of a more or less diluted ethyl alcohol containing traces of the higher-boiling compounds, commonly called fusel oil, the proportion depending on the care exercised by the distiller in stopping the distillation when the vapor temperature rises above the boiling point of ethyl alcohol, and certain flavoring bodies depending on the material employed. The deleterious effects of raw spirits are attributable to the presence of these higher-boiling alcohols, which, by slow oxidation by exposure to the air, are more or less changed and converted into certain ethers which are comparatively harmless.

All spirits are colorless when first distilled, and if kept in glass or earthenware vessels would so remain; but being stored in oak barrels, the staves of which are generally charred, they gradually acquire a more or less topaz hue. It is therefore the tannin and other extractive matters of the wooden casks that produce the color in all spirits made by distillers. Rectifiers, however, generally use caramel or burnt sugar to color their goods.

Most nations are accustomed to consume alcoholic beverages, and in some of the most barbarous tribes a crude method of preparing alcohol is known. For instance, starchy roots are masticated, then spat into a vessel and allowed to ferment, the resulting alcoholic liquid being drunk with much satisfaction. In Alaska the Indians were accustomed to save up the rations of sugar issued to them by the Government till a sufficient quantity was obtained, when a solution was made with water, compressed yeast added, and the fermentation conducted near their fires, and the resulting alcoholic liquid was strong enough to produce intoxication when drunk in sufficient quantity. This resulted in the Treasury agent stopping the sugar rations.

Table II. shows the percentage of absolute alcohol contained in certain typical fermented and distilled liquors, and the results are the means of many analyses.

That cider should contain more alcohol than ale or porter may be a surprising statement to many readers.

The so-called sweet wines are nothing but artificial, that is, they consist of dry wines adulterated with alcohol and sugar. In Europe there are very stringent laws, in most of the wine-producing countries, against the sale, as wine, of any wine which is not the product of the fermentation of the juice of fresh grapes. All wines made from the second pressing of the marc or grape residue, with the addition of sugar, alcohol, etc., are compelled to be labelled, sold, shipped, etc., as artificial wines. These sweet wines are really diluted brandy sweetened; their alcoholic and sugar contents are nearly equal, and together form about one-half of the volume of the liquid.

[1] Rev. Ques. 4 s., T. 2, 1888, pp. 1369, 1423.

Table II.—Showing the Percentage of Absolute Alcohol in Certain Typical Beverages.

Beverage.	Number of Analyses.	Per Cent Absolute Alcohol. By Weight.	By Volume.
Weiss beer, Berlin	26	2.73	3.42
" " American	28	1.73	2.18
Draught beer	205	3.36	4.20
Lager "	258	3.93	4.93
Export "	109	4.40	5.50
Bock "	84	4.69	5.86
Porter	40	4.70	5.87
Ale	38	4.73	5.91
Cider, American sweet	6	1.40	1.76
" well fermented	7	5.17	6.45
Wine, Europe	1,287	8.41	10.43
" California	130	8.64	10.73
Whiskey, Scotch	—	42.80	50.37
" Irish	—	42.30	49.90
" English	—	41.90	49.40
" American, corn	—	42.50	50.00
" " rye	—	42.50	50.00
" Russian	—	54.20	62.00
Brandy, French	—	47.30	55.00
Rum	—	42.20	49.70
German schnaps	—	37.90	45.00

The different varieties of beer and ale are among the lightest of the alcoholic beverages, the amount of alcohol they contain depending on how far the fermentation of the wort was conducted. In their endeavor to supply a light-colored beer, brewers are resorting to the use of malt substitutes, as glucose, as giving them more satisfactory results,—a practice that presents no objection on the score of health. Such light-colored beers, however, lack the full and fine flavor of a beer made from malt exclusively. In bottling their beer, in order to prevent further fermentation, resort is had to antiseptics, a practice which should be prohibited by law, as the quantity and kind of antiseptic used varies in the different bottling establishments: some brewers and bottlers, however, do not use antiseptics. The use of alkaline bi-carbonates to increase the head of gas is another adulteration of bottled beers. When hops are scarce, and consequently dear, resort is had to other bitters, as gentian and quassia; but that brewers habitually employ unwholesome bitters, as strychnine and picric acid, is extremely unlikely, because, if for no other reason, their sales would decrease on the mere suspicion of such practice. According to the internal revenue law (R. S. 3,337), every brewer is compelled to keep books in which he enters from day to day the kind of malt liquors made, the estimated quantity produced, and the actual quantity sold, and an account of all materials, including grain or malt, purchased by him for the purpose of producing such fermented liquors. At the end of each month the brewer has to send a copy, duly attested under oath, of

such daily records to the Commissioner of Internal Revenue at Washington. If in such returns the employment of unwholesome material was reported, an investigation would be made by the proper revenue officer, and an explanation demanded from the brewer. Thus some sort of check is exercised over the use of poisonous materials. The production of distilled and fermented liquors in the United States since 1863, when a revenue was imposed on the same, is shown, at intervals of five years, in table.

Table III.—Showing Production of Distilled and Fermented Liquors, at Intervals of Five Years, in the United States.

Year ending June 30.	Liquors [1] (Gallons).	
	Distilled.	Fermented.
1863	16,149,954	62,205,375
1868	7,224,809	190,546,553
1873	65,911,141	298,633,013
1878	50,704,189	317,485,601
1883	76,762,063	550,494,652
1888	71,565,486	765,086,789
1890	83,535,165	854,420,264

While the production of distilled liquors has only increased five times, that of fermented liquors is fourteen times, what they were in 1863.

One fluid ounce or half a wine-glass of whiskey, rum, or gin, containing fifty per cent by volume of absolute alcohol, is equivalent in alcoholic strength to five ounces of light red wines, as claret; eight ounces of well-fermented cider; to nine ounces of ale or porter; to ten ounces of lager beer (over half a pint); and to twenty-three ounces of American weiss beer. The intoxicating effects, however, would be more rapid and pronounced in the case of the ardent spirits than they would be with the equivalent amounts of beers, owing to the more concentrated form and consequently quicker absorption in the circulation of the alcohol in the former as compared with its dilution in the latter beverage.

EDGAR RICHARDS.

[To be continued.]

THE STANDARD OF LIVING IN THE UNITED STATES. [2]

IN discussing the standard of living in the United States, I shall consider the producing classes as the people. They constitute the great majority, embody the vital forces of the nation, and represent its life and distinctive character.

An analysis of the conditions which mould the life of the people representing the civilization of the world leaves no room for doubt that the American standard of living is the highest known. The barrier of primogeniture, the repression of caste, the compulsion of social distinctions, are obstructions in the path of ambition which have no existence here. In this country there are no barriers to wealth or station which capacity and persistence cannot sweep away. Physical influences are here in harmony with the intellectual. The western world, in its most temperate zone, with long reaches towards the tropics and approaches towards the north pole, with a breadth bordered by the two great oceans of the world, and spanning practically the possibilities of climate by altitude, is in extraordinary measure independent of other lands. Its resources invite development; and social and political freedom stimulate noblest daring and highest enterprise in their utilization. Here the laborer stands on a relatively elevated plane. If native born, he has no conception of the limitations by which the life of his brother in other civilized countries is restricted. He requires more and better house room, food in larger quantity and greater variety, clothing for his family, books and facilities of education for his children, and something for social life, amusement, and even charities. He is apt to be interested in politics, in social or beneficiary or religious organizations, and oftentimes in all of these. I would not aver that his foreign brother does not possess similar tastes and preferences, but hold that his exercise and enjoyment of them are in more restricted measures, under the limitations of purse and social usages.

Want is not unknown here; the poor and afflicted are everywhere. A comparison with the most favored foreign country will suffice. The Tenth Census returned 66,203 paupers, or 1.32 to every thousand of the population. The record of 1850 was 50,353, or 2.17 to every thousand. This shows a gratifying decrease in pauperism in a period remarkable for increase of national wealth. In England and Wales the number of paupers in 1873 receiving relief in the several unions and parishes under boards of guardians was 887,345, and in 1888 the number was 825,509. The returns do not quite cover the entire population, which was 28,628,804 in 1888, but assuming that they cover all of England and Wales, the number would be 28.8 for every thousand people. This is in violent contrast to the situation in this country.

In the use of food our people are excessive and even wasteful. According to accepted statistics, Great Britain consumes an average meat ration not over two-thirds as large as the American; France scarcely half as large; Germany, Austria, and Italy still less. But the laborer's dietary is improving in those countries. It has already greatly improved in England. The average consumption of meat in the United States is probably not less than 175 pounds per annum. Of other civilized nations, only Great Britain exceeds 100, and many of them scarcely average 50 pounds. The consumption of the cereals, by man and beast, is three times as much, in proportion to population, as in Europe. For the past ten years the average has been 45 bushels for each unit of population, while the usual European consumption does not vary greatly from sixteen bushels per annum. While all is not used as food for man, no small part of it contributes to the meat supply.

The average consumption of wheat for bread is nearly five bushels, and about three bushels of maize and one bushel of oats and rye, or approximately nine bushels for each inhabitant. The average European consumption of wheat is about 3.5 bushels. In the consumption of fruits, the difference between this and other countries is marked with unusual emphasis. Small fruits, orchard fruits of all kinds, and tropical fruits, as well as melons of many varieties, are in profuse and universal daily use in cities and towns, and in the country the kinds locally cultivated are still cheaper and more abundant in their respective localities, though scarce in the regions of recent settlement and those unsuited to a wide range of species. The consumption of vegetables is not excessive.

The American people are no less profuse in clothing than in food. This country is a favored land in fibre production. More than four hundred millions of dollars is the comfortable sum which represents the present fibre product; in the form of cotton, wool, hemp, and flax. There is also experimental production of silk, ramie, sisal, jute, and many others suited to the climate, some of which will ultimately become the foundation of industries. More than half of the material for the cotton factories of the world is grown here, and a third of that is manufactured and mostly consumed at home. If 65,000,000 people require one-sixth of the cotton manufactured in Europe and America for the use of nearly 450,000,000 inhabitants of these continents, and of the millions in India, China, Japan, and other countries obtaining

[1] Under the name of distilled liquors are included whiskey, rum, gin, high-wines, and alcohol; and under the name of fermented liquors are included beer, lager beer, ale, porter, and similar fermented liquors (Ann. Rpt. Com. Int. Rev. 1889).

[2] Abstract of an address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at Indianapolis, Ind., on Aug. 20, 1890, by J. Richards Dodge, vice-president of the section.

supplies from the factories of Christendom, the disparity in consumption between this and other countries must be great indeed. With an average *per capita* consumption of 17.5 pounds of cotton, 8.5 of wool, and a large quantity of silk, linen, and other fibres, the claim of superiority in supply of clothing cannot well be disputed. Thus one-twentieth of the population of the world consumes nearly a fourth of the wool product of the world. If the people of Europe should demand an equally liberal supply, the earth might be scoured in vain for the requirements of such a consumption. As they do not, it may be supposed that a larger proportion of cotton would be needed; but a consumption equal to that of this country would not leave a pound for North or South America, Asia, Australasia, or Oceanica. Indeed it would not suffice for more than a supply of 15 pounds per head to Europe alone.

The satisfaction of the dietetic and sartorial demands of our people is no more imperative than the urgency of their requirements for home-making and ornamentation. No able bodied craftsman or skilled laborer, at forty years of age, needs to pay rent for his habitation from inevitable necessity. If he does, it is because of extravagance, mismanagement, dissipation, or peculiar misfortune. There are crowded and unhealthful quarters in New York and other cities, but they are mainly occupied by lower classes of foreigners. Philadelphia, a city of the largest class, with a million of people by no means exclusively native born, has a dwelling-house for every six inhabitants. Washington is equally well provided with homes largely owned by their occupants. There are log-cabins in the South, board dwellings on the prairies, and even "dug-outs" on the plains of the more distant West; but they are temporary expedients of those too busy in opening farms and growing crops to build permanent houses, and too poor to use their scanty capital in expenditures not immediately and largely productive. A glance at the census records of manufacture of furniture and furnishing, of hardware, of heating and illuminating apparatus, of ingenious devices for saving labor and expediting domestic processes, reveals a wealth of suggestion in the lines of comfort and of luxury in building and ornamentation of homes. The fact is gratifying, as it is indisputable, that a large part of this material goes into the houses of the working classes; if not so much of the costly and elegant, at least a large proportion of the tasteful, ingenious, and comfortable appliances of home equipment and adornment. The evidences of prosperity of the producing classes are not seen alone in well furnished homes, but in many forms of profitable investment in real estate, stocks and bonds, and in money savings banks.

The American citizen is not content to exist as a mere animal. Physical well-being does not limit his desire or aspiration. He is especially solicitous for the welfare and advancement of his children, and freely depletes a limited income in their education and training for a career in life, often upon other than ancestral lines. This tendency may become excessive, and is already to some extent, it must be admitted, creating a distaste for useful industry, and a desire for conspicuous position, for accumulation without labor, and speculative rather than productive occupation. Thus the average American lives upon a high plane, exciting the envy or the emulation of people of other countries, and inducing extraordinary immigration.

A high standard of living requires higher wages. While the wages of European artisans and mechanics, and of farm laborers, have advanced in recent times, they nowhere approach very closely the rate of wages received by the same classes in this country. In an extended discussion of the rate of wages in the leading occupations, before the London Statistical Society in 1880, by Mr. J. S. Jeans, it was claimed as a deduction from available statistics that the wages in the United States were 205 per cent higher than in France, 162 per cent higher than in Germany, and 84 per cent higher than in Great Britain. His estimate of the agricultural wages of Great Britain was 12 shillings per week, or about $150 per annum. The average wages of white farm laborers in the United States, as returned to the Department of Agriculture in May of the present year, is $276 per annum, which is 80 per cent above the rate quoted for Great Britain. According to accepted estimates of the rate of wages of men in the principal trades of France, the wages of women in this country are from 60 to 80 per cent higher. A report of the Department of Labor makes the income of women from regular occupations, as averaged from 5,716 returns in 22 principal cities, $295.54 per annum, with $40 average additional income in 682 of the returns.

Land is the freest thing in America. With nine million farmers and farm laborers, cultivating over five million farms, but a third of the land is taken up, but a small part of that is under crops, and the area under nominal cultivation is superficially treated and scarcely up to half its maximum production. Within a few months past there has been an expression of dissatisfaction with the profits of farming, made mostly by political farmers, and relating mainly to the prices of cereals. Cotton brings fully the average price of the last decade, and the last crop was the largest ever grown; still the ferment of dissatisfaction has leavened the whole South. State and national statistics of the last ten years show that agricultural indebtedness has decreased in that region, that the home market is increasing, and that prosperity is more general than ever before; still farmers appear to be unhappy. It is mainly a case of aroused ambition, and a determination to be felt in business, and especially in politics—and it is in these respects a hopeful indication.

There has been much said about farm mortgages,—quite too much. The most reckless exaggerations have been made, and unfortunately have been repeated in legislative halls, and in newspaper interviews and editorials. If the census can obtain the facts, it will show that they have been magnified enormously to mislead the public. All statistical analysis of available data testifies to the truth of this averment. Much the largest proportion of the farm mortgages of the country are for lands and improvements, increase of investment, settlement of estates, and release to sons by wealthy retiring farmers, and are evidences of enterprise and self-reliance and thrift.

Shall the standard of living be maintained? This is a grave question. Upon its maintenance depend the future education, enterprise, independence, and prosperity of the people. It is pertinent also to frame the inquiry, Will it be maintained? for there are influences, from without and perhaps from within, that possibly tend to inevitable lowering of the present standard. Our population has doubled in less than thirty years. There is every reason to believe that it will exceed the present population of Europe before the end of the next century. With five times the present number of people to feed and clothe, can they be fed and clothed as well? It may be, if they continue industrious, if the proportion of non-producers does not increase, if labor shall be distributed harmoniously in production, and if the laborer can secure a just recompense. If the present disregard of the requirements of national economy in production shall continue, if we remain idle at home and go abroad to supplement the deficiencies created by our own inertia, a lower level will be inevitable. Something cannot come from nothing. No nation can consume more than it produces. It is useless to ask what natural productions we can profitably grow. What can we not grow? is a more appropriate question.

As the scale of expenditure must be limited by income, by wages, the rate of wages must be maintained or the standard of living will inevitably be lowered. Without reduction of wages and decrease of cost of manufacture, is enlarged exportation of surplus products possible? If not, it will be better to live well at home, without a surplus, than to live meanly in order to help foreigners to better living.

By comparing our increase of population, to be fed here, with the increase of foreign dependents on our surplus, we find at least twenty new domestic mouths to fill for every one in foreign lands. In the last decade there has been decrease; in the previous one there was considerable increase. Only crop disaster, threatened famine abroad, can enlarge the foreign demand. While our population is enlarging at the rate of nearly two millions per annum, our increase of production will be needed mainly at home, and it is an even question whether the foreign requirements will increase or decrease. It is therefore clearly apparent that the demand for augmented production will come mainly from growth of the population of the United States. This makes the exportation of the

surplus of agriculture a matter of small comparative importance, and of manufacture a minor consideration.

But the record of the growth of exports of domestic manufactures does not warrant the assumption that higher wages are an inevitable bar to exportation. Such exportation in the last twenty years has much more than doubled, while the increase of population was only seventy per cent. There is a constant tendency to greater effectiveness of labor by the acquisition of skill, and especially by inventions and ingenious appliances for the saving of labor.

In certain manufactures, in which the cost of labor has been double that paid by foreign competitors, exports have increased beyond the advance in population, in some cases ten, twenty, even thirty fold. This ability to export, notwithstanding the higher rate of wages, is not as yet general, but there is a possibility, yea, a certainty, of gradual enlargement of the list and especially the volume of exportable goods, partly through superior skill, and efficiency of labor, and perhaps in larger part from labor-saving machines and processes, and from the distinctive peculiarities and marked availability for their intended uses in the manufactured goods. The ability to export, therefore, is less a matter of muscle of the mechanic than of inventive power and of cultivated intellect in the forms and adaptations of the thing manufactured. The higher wages may thus be neutralized by the aid of mind far more than of muscle.

An analysis of the facts that illustrate the standard of living in the United States leads to the inevitable belief that the people, the worker in all the hives of industry, the constructive forces of the nation, exist upon a higher plane than those of any other country. The following results of this investigation are presented:—

1. The American citizen is free from the bondage of feudalism, from the domination of kingly or aristocratic mastery, and from the control of caste. He is an independent individual, a sovereign in his own right, voluntarily submitting to laws of his own making, to limitations of natural rights for the general welfare. His aspirations are checked only by a wise judgment of his capacity, and his elevation in the walks of life is limited only by his ability and opportunity. He is the master of his own career and the maker of his own fortune.

2. Inducements to action lead to activity in effort; intense and persistent application causes waste of tissue, of nerve and muscle; and a liberal ration becomes necessary for repair of waste. The opulence of nature makes rich provision for the largest alimentary liberality. Therefore large consumption of all the elements of nutrition is assured, fully fifty per cent more than that of the average in Europe, and more than twice as much as that of the less favored peoples of the world.

3. The variety and abundance of vegetable and animal fibres, by the favor of soil and climate and the energy of man, are no less remarkable than the range of species and ease of cultivation of the grains and fruits. The development of taste and the effort to rise in social life conspire to create an extraordinary demand for clothing, so easy to gratify, and so increased by the facility of its gratification.

4. It is a natural corollary of these facts, as stated heretofore, that "the satisfaction of dietetic and sartorial demands of our people is no more imperative than the urgency of their requirements for home-making and ornamentation." Liberal demands in food and clothing are only consistent with a high appreciation of comfortable housing. Bed and board are indissolubly joined.

5. Such a scale of expenditure presupposes a higher rate of wages, a larger income than that of average peoples. The facts show that our wages are from fifty to one hundred per cent higher than those of the workmen, in their several classes, of the most favored nations, twice as high as the average of certain countries, and three times as high as that of certain others.

6. With seventy acres of land for every farm worker, three hundred and fifty bushels of cereals for each, with abundant industrial or surplus crops, meats, fruits, and vegetables in equal abundance, and markets greedy for the surplus, the farmer is in condition to live and thrive, or know the reason why his profits do not meet his expectations.

7. The question arises, Shall the present standard of living be maintained? It is a point upon which hang "the future education, enterprise, independence, and prosperity of the people" of the United States. It depends on the industry of the producing classes,—their wisdom in the distribution of their labor towards a production that shall meet their wants. If idleness shall be encouraged, production limited, importation enlarged, and dependence on foreign countries fostered, wages will be reduced, and the ability to purchase, as well as the volume of production, will decline. If the advice of public and private teachers of repressive economy, to buy every thing abroad and sit down in the enjoyment of the luxury of laziness at home, shall become the law of the land, short rations will follow, and high prices will only be abated by the inability of our people to purchase for consumption.

8. If, on the other hand, we determine that there shall be no decline in production, agricultural or other, we must provide for it manfully by our labor, realizing that no nation can live beyond its income, or consume more than it produces.

9. Unless the largest variety of production shall be encouraged, and the highest skill shall be stimulated in the endeavor to meet all the wants of our people by the results of our own labor, it will be impossible to have a surplus for export. The example of Spain and India, in contrast with that of England and Belgium, or of France and Germany, enforces this conclusion. But in view of the fact that high wages must co-exist with a high standard of living, as the history of wages in all countries shows, can we export a surplus produced by high wages? Our experience of the last twenty years shows that our exports of domestic merchandise, produced by the highest wages of the world, have increased much faster than population, some a hundred, some a thousand fold — not because of the fact of high wages, but in spite of it; not so much by the force of muscle as by the creative power of mind. The creations of invention, in the lines of taste and utility, adaptation and expedition, can nullify the obstruction of high wages far more than advance in skill and manual dexterity. It is a matter of time, of determined effort, of high endeavor, to render high wages consistent with large exportation of surplus; but the future will accomplish it, if the present scale of living and rate of wages of the American people shall be maintained.

NOTES AND NEWS.

AT a meeting of the Wellington Philosophical Society, New Zealand, Mr. Hulke exhibited a spider that carried its young on its body without web or filament until they were able to run.

— Sponge would seem to be an unpromising material for a sculptor to work upon; but that a work of art may be chiselled, or rather scissored, from it is proved by a life-size statue in sponge now in the sponge department of McKesson & Robbins, wholesale druggists, on Fulton Street, this city. The statue represents a Greek sponge-gatherer standing in the bow of a boat, pole in hand, gazing intently through a water-telescope at a piece of sponge which he is supposed to be endeavoring to secure. The figure is composed of numerous pieces of what is known as leathery potters' sponge, carefully matched as to color, texture, and shape, so that the statue appears to be cut from one large sponge. The artist has done his work well, the face especially being an excellent piece of carving.

—Professor T. Hirsch, reporting for the Committee of the Mechanic Arts of the "Société d'encouragement pour l'Industrie Nationale" of France, at the meeting of July 11, states that the committee has analyzed the work of M. Dwelshauvers-Dery, and finds that "the method of calculation proposed by him is at once original, and fruitful of results. In its application to the experiments of Mr. Donkin, its author demonstrates the course to take in computation, and thus facilitates the work of all those who desire to study such questions. It constitutes an important advance in the study of such complex phenomena as those of which the steam-engine cylinder is the seat." The committee proposed very hearty thanks from the society to the author of this work; they were accorded, and the memoir of M. Dwelshauvers-Dery was directed to be inserted in the bulletin *in extenso*.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

HEALTH MATTERS.

Should Beer be drunk out of Glass?

THE Boston *Medical and Surgical Journal*, quoting from a German industrial periodical, says that a spirited contest has for some while been waged in Germany between the beer-glass and the stone-mug factions. Dr. Schultze claims to have established, by a very extended series of experiments, that beer, by as little as five minutes' standing in any glass, even when cold and in the dark, will be materially affected both in taste and odor. He sustains his claims by trial tests confirmed by some one hundred persons. The change, he thinks, is due to the slight solubility of the glass substance in the beer. This is of further importance from the fact that the glass most generally used contains lead, which has been added for its better and more easy manipulation in manufacture. From a series of experiments made upon glasses obtained from the leading sources of supply, he determined that one cubic centimetre of beer, by five minutes' standing in glass, dissolved 6 to 26 ten-millionths of a milligram of the glass substance containing 0 to 48 thousand millionths of a milligram of lead-oxide. This small quantity of glass substance he claims affects the taste of the beer, and, if it also contains this lead, renders it objectionable from sanitary reasons. He recommends for use as a normal test drinking vessel, whereby one can surely and easily determine the fitness or unfitness of any other vessel, a silver mug gilded upon its inner surface, the beer to be first tasted out of the silver mug, and then out of the other vessel. He gives the following comparative scale of fitness for beer vessels as made out of different material: All lead-glazed mugs are to be wholly excluded. Covered salt-glazed stone mugs he ranks as good, but tin ones as better, and gold-lined silver mugs as the best. Hard lead-free glass he ranks as poor, but soft-pressed glass as still poorer, and poorest of all lead glass, either pressed or blown. Porcelain, even that made at Meissen, he thinks not serviceable. Wood mugs are doubtful on account of the pitch varnish, which, even if it should not flavor the beer, yet is liable to induce loss of sleep and headache.

Dr. Schultze's conclusions have been discussed and disputed by Professor Linke, he claiming that, according to Schultze's own showing, 20,800 litres of beer out of the very worst kind of lead beer glass must be drunk within fifty-seven years, in order to take in even one milligram of lead-oxide into the body of one drinking a litre of beer a day. From an average quality of lead glass, it would take 74,000 litres and two hundred and three years to accomplish the same. Moreover, he claims that Schultze's lead quantities are seventy-six times too great, and that therefore it would require that much longer time to imbibe that small amount of lead.

A New Butter Substitute.

According to the Boston *Medical and Surgical Journal*, M. Heckel and Schlagdenhauffer have discovered and reported upon a certain Spanish broom-like bush, native of the west coast of Africa, which belongs to the Polygala family, and to which they have given the specific name of butyracea. The native name of the bush is Malonkang or Ankalaki. Its seeds yield 17.5 per cent of a yellowish butter-like fat of a very agreeable nutty flavor, and which could well serve as a substitute for butter. The fat softens between 28° and 30° C., beginning to melt at 35°, but does not become fluid below 52°. Upon cooling, it remains fluid for a long time, only beginning to solidify at 33°, when it regains its original consistency. Its density at between 35° and 38° C. is 0.904. It saponifies very easily with alkalies, and contains 31.5 per cent olein, 4.8 per cent free palmitic acid, 57.54 per cent palmitin, and 6.16 per cent myristin. It contains small quantities of formic and acetic acids, but no butyric or valerianic acid, and therefore it does not easily become rancid.

Is Fair Hair becoming Extinct?

The *British Medical Journal* concludes an article on hair as follows: "On various grounds, therefore, it would seem as if the fair hair so much beloved by poets and artists is doomed to be encroached upon, and even replaced, by that of darker hue. The rate at which this is taking place is probably very slow, from the fact that Nature is most conservative in her changes."

Denicotinizing Tobacco Smoke.

According to the *British Medical Journal*, Dr. Gautrelet, of Vichy, claims to have discovered a method of rendering tobacco harmless to mouth, heart. and nerves without detriment to its aroma. According to him, a piece of cotton wool steeped in a 5 to 10 per cent solution of pyrogallic acid inserted in the pipe or cigar holder will neutralize any possible ill effects of the nicotine. In this way not only may the generally admitted evils of smoking be prevented, but cirrhosis of the liver, which in Dr. Gautrelet's experience is sometimes caused by tobacco, and such lighter penalties of over-indulgence as headache and furring of the tongue, may be avoided. Citric acid, which was recommended by Vigier for the same purpose, has the serious disadvantage of spoiling the taste of the tobacco.

LETTERS TO THE EDITOR.

Source of the Rocky Mountain Precipitation.

IT has often been a question whether more of the moisture of Colorado came from the Gulf of Mexico or from the Pacific Ocean. The fact that the rivers that drain the western slopes of the Colorado mountains, such as the Yampa, the White, the Grand, and the San Juan, are larger in the aggregate than the streams that flow eastward, is proof that the Pacific is better watered than the Atlantic slope. Most of this precipitation occurs during the winter as snow. The snow-fall rapidly increases as we

go from Central Utah, at an elevation of 4,500 feet, north and eastward to the high mesas of the Yampa and White Rivers, at an elevation of 8,000 to 10,000 feet, where several feet of snow cover the ground for two or three months. In that region during the great snow-storms the wind usually blows from the south or south-west. Some precipitation occurs on a north wind, but it is preceded by west or south-west winds. It thus becomes evident that the precipitation on the western slope of the mountains is chiefly derived from the Pacific. Where does the moisture come from that falls on the eastern slope?

The larger part of the precipitation on the eastern slope of the mountains takes place while the surface wind is blowing from the north or some quarter from the eastward: hence it has often been stated that this is Atlantic moisture. Doubtless much of it comes to us from the Gulf of Mexico by way of the Great Plains, yet in most cases it is easy to prove there has been a large supply from the Pacific.

First as to the storms of the colder months from October to May. These storms usually cover large areas. The precipitation is from stratus or cumulo-stratus clouds moving over the mountains. Several days of south-west wind in most cases precede the shifting of the wind into the north or some eastward quarter, at which time the precipitation takes place. During some of these storms the wind blows from some westward quarter for several days, so that it is often certain that sufficient wind has passed eastward to permit air direct from the Pacific Ocean to reach eastern Colorado and the Great Plains. As the storm centre advances, this same air must often be deflected backward toward the mountains. It is obvious that in the case of cyclonic storms there is an influx of air from the west (the "Chinook" winds) in the region south of the storm-centre. In the larger storms the distance travelled by the wind is so great as to permit air direct from the ocean to cross the mountains.

Occasionally storms break upon us without the premonitory south-west winds. Thus a blizzard struck south-eastern Colorado Oct. 30, 1889. The winds had been light and variable. Suddenly the wind shifted into the north to north east, and for several days raged at a high velocity. There was a heavy precipitation of snow, and not even the rotary snow-ploughs could keep the railroads open for travel. Several thousand miles of wind from the direction of the plains and Missouri valley were driven obliquely up the slopes of the mountains. The signal maps show that the storm-centre passed north-eastward over northern Texas, and the area of west winds was far south of here. Over Mexico and Texas there must have been a large movement of Pacific air eastward.

Second, the summer thunder-storms. These also are preceded by west to south-west winds. In general, the longer the west winds continue, the more violent will be the storms when the final break-up comes. A common type of development of the July storms is the following. Warm winds begin to blow from the south-west, and continue four or five days. The temperature becomes progressively hotter. Some day we see a cumulus-cloud over the mountains begin to throw out filmy streamers above and a fringe beneath. It rains a little above timber-line, and there may be a discharge of cloud-lightning. Then, as the cloud passes eastward over the plains, it loses its ominous fringe, and becomes an ordinary sleepy cumulus with a sharply defined edge. Next day the attempt at a storm is repeated, the fringe is longer and the cloud is larger, but the ranchman who is wishing for rain looks on in disgust at the abortive effort, and remarks that there is a lack of ginger in the upper air. Meantime the general movement of the lower mile or two of the air continues from the south-west. After a few more days of failure, we some day see high cirrus streamers and films begin to form before noon. Soon after, there are big cigar-shaped masses of cirro-stratus far below the cirrus. Still farther below are innocent-looking cumulus-clouds with rather definite margins. As the afternoon advances, one of these begins to bristle with an indefinite fringe above and below. The fringes grow longer. Presently a marginal belt of rounded festoons appears outside the central fringes and beneath the storm-cloud, while above it the high streamers radiate outward in the sheaf-of-wheat pattern. In the mean time a halo, or part of one, has appeared around the sun in the higher filmy clouds. Before midnight there will be hail and cloud-bursts on the mountains, and these storms will go hundreds of miles eastward onto the plains. It often happens that the first storms go northward or north-eastward. The next day they shift toward the west. In a few days they will come from the north-west or north. Then the air will be cool, the general movement of the air is from the north, and there will be no more storms until after another season of south-west winds.

Thus the summer showers, as well as the winter storms, derive most of their moisture from the Pacific. There are different types of these local electrical storms, but they all are alike in one respect: they appear as local disturbances in the midst of an area of relatively heated south-west or west winds.

The present summer has been remarkable for the amount of Pacific air. Heretofore, during several years of observation, the wind has never been known to blow briskly from the south-west for more than one to three weeks without the formation of some kind of storm, or at least attempted precipitation, which interrupted the west wind.

This year, during late May, June, and July, there were more than two months of almost constant wind from the south-west over the mountains. It should be noted that the wind in the valleys, near the base of the mountains, is often variable, and there are local movements this way and that, while all the time the clouds on the mountains show that the wind is there from the south-west. Several thousand miles of air fresh from the heated regions of Southern California, Utah and Arizona, have passed eastward over the mountains. Hot weather prevailed simultaneously over eastern Colorado, Kansas, Missouri, and eastward. Such a movement I have not noticed before in eight years of observation. The thunder-storms have this year been late in forming in Colorado, notwithstanding the great supply of Pacific air. For nearly two months the clouds seemed to be at a rather low level in the air, and there was much less of the high cirrus than usual. No solar halos appeared till about the middle of August. Their appearance was followed by very violent hail-storms and wash-outs. In short, we appear for once to have had for most of the summer too much Pacific below, and too little Arctic up above.

It is noticeable that the tornado belt this summer lies far to the north and east. Is not this the result of the vast body of Pacific air which has invaded the Mississippi valley? It appears as if for some cause the meeting-ground of the warm and cold currents had, during the early summer, been pushed north-eastward to the line from Minnesota to New England, instead of the ordinary Missouri-Ohio line. G. H. STONE.

Colorado Springs, Aug. 23.

Professor A. Graham Bell's Studies of the Deaf.

I AM always ready to welcome intelligent criticism of my labors on behalf of the deaf; but the articles published in *Science* (Aug. 15, pp. 85–88; Aug. 29, pp. 117–119) from the pen of Mr. W. J. Jenkins unfortunately contain so many misstatements of fact as to render reply distasteful.

Mr. Jenkins commences his criticism (p. 85) by "entering a gentle protest" against the truth of a statement I never made; and he ends it (p. 119) with a long paragraph containing a series of statements relating to the census of 1880, no one of which is correct. The intervening matter is so full of inaccuracies, that I should take up a great deal of your valuable space were I to attempt to point them all out.

His chief objective is an attack upon what he calls my "theory of a deaf-mute variety" (p. 85); but he nowhere states exactly what this theory is, so as to enable your readers to judge for themselves whether or not his attack is well founded. Let me therefore supply this deficiency.

The theory referred to is contained in a paper, "Upon the Formation of a Deaf Variety of the Human Race," which I had the honor of reading before the National Academy of Sciences, Nov. 13, 1883 (see *Memoirs of the National Academy of Sciences*, vol. ii. pp. 177–262).

In the preface (p. 180) the theory is formulated as follows: "If the laws of heredity that are known to hold in the case of animals

also apply to man, the intermarriage of congenital deaf-mutes through a number of successive generations should result in the formation of a deaf variety of the human race." For example: let some of the congenitally deaf marry congenital deaf-mutes; then let some of their deaf children marry congenital deaf-mutes, and some of *their* deaf children marry congenital deaf-mutes, etc., then the percentage of deaf children born of such marriages will increase from generation to generation, until finally all, or nearly all, of the children will be born deaf. The families of which this would be true would then constitute a variety of the human race in which deafness would be the rule instead of the exception.

Now, Mr. Jenkins is greatly exercised over the fact that all the distinguished scientific men whose opinions are quoted in the little pamphlet entitled "Facts and Opinions relating to the Deaf," admit this theory to be true. He gets over the difficulty, however, when he discovers that these gentlemen all belong to a scientific association of which I also am a member; and he says, "A member of their own fraternity has asked them their opinion on a theory of his own formulating; and, in complimentary deference to a great name, they have indorsed the theory."

I need make no further comment upon this than to say that the "fraternity" refers to no less a body than the National Academy of Sciences; and that the gentlemen who are so willing to subordinate their real opinions out of complimentary deference to me are Professor Edward D. Cope, Professor Alpheus Hyatt, Dr. H. P. Bowditch, Professor William H. Brewer, Professor Simon Newcomb, and Professor W. K. Brooks.

But to all his numerous mistakes Mr. Jenkins puts a climax when he credits the above theory to me. Such an error might be pardonable in one not connected with the Hartford School for the Deaf; but it is surely unpardonable that Mr. Jenkins should not know the author of the theory to have been the principal of the very school in which Mr. Jenkins himself is an instructor.

In my "Memoir" (p. 196) I quote the words of the late Rev. W. W. Turner, as follows: "It is a well-known fact that among domestic animals certain unusual variations of form or color which sometimes occur among their offspring, may, by a careful selection of others similar and by a continued breeding of like with like, be rendered permanent, so as to constitute a distinct variety. The same course adopted and pursued in the human race would undoubtedly lead to the same result. . . . Early consideration of philanthropy, as well as the interests of congenitally deaf persons themselves, should induce their teachers and friends to urge upon them the impropriety of intermarriage" (from a paper upon "Hereditary Deafness," published in 1868; for further references see my *Memoir*, p. 196).

The above is the theory for which I have so often been denounced. But the statistics of the "Memoir," to which alone I can lay claim, and which have led me to fear that a deaf variety of the human race is actually in process of formation in America, have never been seriously questioned.

Many statistics have since been collected by deaf-mutes themselves, and by their teachers, to show that there is no cause for alarm; but their figures all demonstrate that the percentage of deaf offspring born of deaf-mute intermarriages is many times greater than the percentage of deaf offspring born of the marriages of those who hear.

The testimony of the present principal of the Hartford School, Mr. Job Williams, is specially strong upon this point, although it is adduced to sustain the opposite contention (see *Facts and Opinions*, pp. 42–50).

In view of these facts, we cannot but note with alarm that many of the most prominent teachers of the deaf in America advocate the intermarriage of deaf-mutes. Dr. Philip G. Gillett, superintendent of the Illinois Institution for the Education of the Deaf, says (*Facts and Opinions*, p. 53), "I do not discourage the intermarriages of the deaf, as they are usually more happily mated thus than where one of the parties only is deaf. The deaf need the companionship of married life more than those who hear, and it is a gross wrong to discourage it."

Dr. Gillett is probably the oldest teacher of the deaf in America, —not oldest in years, but oldest in service, —and he is looked up to as a guide by very many in the profession.

Much good might arise from a comparison of views between Dr. Gillett and those scientific gentlemen who have given most attention to the subject of heredity. May I ask him, through the columns of *Science*, what would be his advice in such a case as the following?—

A young man (not a deaf-mute) became deaf in childhood while attending public school. He has one brother who is a deaf-mute, and another who can hear. Two others of the family (believed to be hearing) died young.

The father of this young man was born deaf in one ear, and lost the hearing of the other subsequently from illness. He had a congenitally deaf brother who married a congenital deaf-mute and had four children (three of them congenital deaf-mutes).

The mother of the young man was a congenital deaf-mute, and she also had a brother born deaf.

The paternal grandmother of the young man was a congenital deaf-mute, and she had a brother who was born deaf. This brother married a congenital deaf-mute, and had one son born deaf.

The great-grandfather of this young man (father of his paternal grandmother) was a congenital deaf-mute; and he was, so far as known, the first deaf-mute in the family.

Thus deafness has come down to this young man through four successive generations, and he now wants to marry a congenital deaf-mute.

The young lady has seven hearing brothers and sisters, and there was no deafness in her ancestry, but she herself is believed by her family to have been born deaf.

Dr. Gillett must not think that this is a purely hypothetical case, for it is not. The parties are engaged, but the marriage has not yet been consummated, and I know that Dr. Gillett's advice would have weight with the young people.

The teacher of the young lady has been consulted, and she feels her responsibility deeply. Her heart is with the young couple, and she desires their happiness, and yet her judgment is opposed to the union.

Will Dr. Gillett tell us what his advice would be in such a case?

ALEXANDER GRAHAM BELL.

Washington, D.C., Sept. 1.

Treatment of Snake-Bites.

IN *Science* of Aug. 22, 1890 (p. 107), it is stated that Professor Kaufmann strongly condemns the use of large quantities of alcohol in the treatment of snake-bites, as he thinks it paralyzes and depresses the nervous system.

Now, this paralyzing and consequent depressing effect of alcohol in snake-bites is just wherein its medicinal or remedial value lies; for by this paralyzing effect, tissue change and general metamorphoses of both the solids and fluids of the body are retarded, and the reactionary susceptibility of the system is blunted and benumbed; so that the venom is more slowly fed into the system, which is, by the paralyzing effects of the alcohol, rendered less susceptible to disturbing influences. Thus the *vis medicatrix naturæ* is given more time in which to eliminate, and in smaller quantities, the venom from the system.

This is another striking proof of the truth of the ancient aphorism, "Do not allow your theories to interfere with your practice."

Q. C. SMITH.

Austin, Tex., Aug. 26.

Temperature in Storms and High Areas.

ONE of the first practical discussions of this question was published in 1886 by M. Dechevrens, of Zikawei, China, and a translation of this paper will be found in the *American Meteorological Journal* for August, 1886. An independent investigation of this same question was carried on in this country before the above publication, the results of which will be found in the journal quoted above for October, 1887. The latter study showed that the temperature fluctuations were almost exactly the same, and had the same phases, both at the base and summit of high mountains, which was exactly opposite to the results obtained by M. Dechevrens. Dr. Hann of Vienna espoused the cause of M. Dechevrens, and tried to show that the observations at Sonnblick indicated the

same effect. Inasmuch as these two foreign discussions reached conclusions directly contradictory to all the teachings of meteorology, the importance of determining where the error lies, and of establishing the truth, will readily be seen.

A careful study of the question will show that the entire difficulty, and apparent contradiction, has arisen from a neglect of the consideration that at considerable heights in the atmosphere a lower temperature has a tendency to contract the air and cause a diminution of pressure, and a higher temperature just the reverse. The best example of this is to be found at Pike's Peak (14,134 feet), where the lowest pressure ever recorded was 16.88 inches. on Jan. 20, 1883, while the temperature at the summit was—34°, and while a high area of great magnitude was passing at the base. This shows that we must ignore fluctuations in pressure at the high station, and consider only those below. When this is done, the whole difficulty vanishes at most stations. Dr. Hann seems to have found a few cases where an increase of pressure at the lower stations near Sonnblick has been coincident with an increase of temperature on the mountain 8,700 feet above. It may be well to pursue this discussion under a slightly different form, and unite the results as obtained at Mount Washington (6,279 feet) with those in Austria.

The plan proposed is simply to compare side by side the temperature fluctuations at both base and summit. If we had balloon observations at 10,000 feet and others at sea-level on the earth's surface, such comparisons could be made readily and accurately; but it should be noted that when we use mountain observations, especially those on ranges and not isolated peaks, we cannot hope for an absolute comparison. The difficulty will be enhanced if our base station lies at some distance from the mountain, though in the case of an extended range we may obviate some of this source of error by taking stations on both sides of the range. It will be universally admitted that, north of the equator, the usual fluctuations of temperature at sea-level on the passage of storms and high areas are perfectly well known, though these may at times be masked or even reversed, as, for example, when the centre of the storm passes just a little south of the station. In general, as a storm comes up, there is a southerly breeze and a great increase of temperature. This increase of temperature is observed even though there be a calm and the sky be clouded, hiding the sun's direct rays. We naturally conclude that this heat condition is an accompaniment of the storm, and is largely independent of the sun's direct influence in raising the temperature. Exactly the reverse of this is experienced when a high area or a clearing condition approaches a station. Here the sky is perfectly clear, and though the sun has apparently a much better opportunity to heat up the earth and air, still we find a marked lowering of temperature. This is the normal condition, but suppose we find that with the increased pressure there is increased temperature at sea-level, or that the clouds come up and there is rain, then we must conclude that the conditions are abnormal, and in any general discussion or comparison of temperature conditions at the base and summit of a mountain we must give such cases a separate study and not unite them with the normal fluctuations. It seems quite plain that we may draw curves showing the observed temperatures at base and summit and compare them directly. There is a slight difficulty, however, which must first be overcome, and it is this. At the earth's surface there is a marked daily effect from the sun's direct heat which generally causes a steady rise of temperature from sunrise to about 3 P M., and this would mask the other conditions. It would be a great advantage if we could use observations more than once a day, as the maximum point in the passage of a storm and a minimum point in a high area might occur at any hour of the twenty-four. One way of eliminating this diurnal range would be to apply the difference between the monthly mean and the mean for any hour to each daily observation of that hour; for example, we would have to add a little to nearly every sunrise observation and subtract from nearly every maximum observed; but a better way still would be to take the mean of the hour which agrees most closely with the mean for the day, and apply the difference between that and the hourly mean to each observation, as this would save one-third of the labor when we are studying three observations each day. In the latter case the 9 P.M. observation, for example, would be projected without modification. In projecting the temperature curves it was found most convenient to use the night observation rigidly and to interpolate the morning and afternoon observations if either or both differed widely from that. For Mount Washington the station at Burlington was chosen for the base until it was closed in 1883, and after that Portland. After projecting the curves there was found to be a most extraordinary similarity between the changes at the base and summit. To illustrate this I have drawn Fig. 1, which gives the fluctuations for January, 1876. I think this will be recognized as a perfect accordance. The slight hitch on the 16th on the summit has only a very slight bending at the base, but it is noticeable. Such slight coincidences were ignored in the summing-up. In the 78 colder months there were 1,128 accordances out of 1,240 cases, or 91 per cent; and in the warmer months, April, 1873, to September, 1879, 42 months, there were 553 accordances in 601 cases, or 92 per cent. It would seem that even if there were no explanation for these few discordances, the evidence is conclusive that whatever fluctuations of temperature take place at the base, they are faithfully repeated at the summit. The comparison will seem all the more effective when we reflect that this thin strip between these curves represents a difference in vertical height of over 6,000 feet.

I have made a careful study of the discordances, and find that they can all be explained under the following heads: (1) Often the curve turns at the summit before it does at the base, or, in other words, a lagging at the base causes the summit curve to cross that at the base. (2) At other times there is an abnormal condition of the upper atmosphere, a fall of rain, for example, in the centre of a high area, which shows a remarkable disturbance of temperature conditions. (3) There is sometimes in a high area a perfectly clear sky, which promotes intense radiation from the soil at the base, but which has no counterpart at the summit. For example, during the progress of a high area which culminated at 4 P.M., Nov. 16, 1874, the following temperatures were observed:—

	15			16			17		
	7 A.M.	4 P.M.	11P.M.	7 A.M.	4 P.M.	11P.M.	7 A.M.	4 P.M.	11P.M.
Burlington	28°	35	37	40	36	31	36	44	46
Mount Washington	13°	19	18	15	15	22	23	27	30

Here the minimum temperature at the summit was reached during the afternoon of the 16th, but the great radiation after dark at the base gave a minimum at that point at night, though it is also probable that a portion of this was due to a lagging at the base. (4) There are occasions in the centre of a high area, which has only a very slight onward motion, when the sun's heat appears to have an abnormal effect upon the air column, causing an increase in temperature at the summit above that at the base. In all the cases examined there were only two under this last head. There is no difficulty at all in explaining all the exceptions, and these may fairly be said to *prove* the rule. The evidence is overwhelming that if the principles just laid down are accepted there is a marked increase in temperature at 6,000 feet height in our storms, and a decrease in our high areas.

It is a very interesting fact that the distance between the curves at the base and summit of Mount Washington during the passage of storms and high areas seems to be nearly constant. The slight crowding on the right-hand side of the curves between Nov. 6 and 11, and 26 and 30, is due to the fact that the base is to the northwestward of the summit, and hence the latter lags behind a little as a storm moves to the east. Does not this similarity prove that there is no uprush of air in the storm, nor a downrush in the high area?

To complete this investigation it is necessary to make a similar study of the observations used by Dr. Hann in arriving at his conclusions. It should be borne in mind that Sonnblick, the mountain station used by Dr. Hann, is almost entirely outside of the

track of storms and high areas. Mount Washington, that we have just studied, lies almost directly in the path of storms that cross the United States, and a little to the north of the ordinary path of high areas. Sonnblick is also on a long range of mountains, and not an isolated peak. The nearest base station on the north side is Salzburg (53 miles), and on the south side Görz (100 miles). The difference in height between Sonnblick and Salzburg is 8,722 feet, which is not quite one-half greater than Mount Washington above Burlington. On projecting the temperature curves at these Austrian stations we are struck at once with the

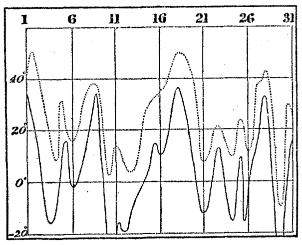


FIG. 1.

Full curve, Mount Washington; dotted, Burlington. Vertical lines are at intervals of five days, horizontal lines at each twenty degrees Fahrenheit.

enormous difference in the character of the curves. I have shown, as compared with those in this country, the curves for the month of March, 1888 (Fig. 2). We see at once that there is a marked similarity in the bendings of the curves; but the fluctuations are very moderate, and do not have sharp points, as was to be expected from what has already been said. One of the more marked discrepancies in Fig. 2 occurs on the 26th, which shows a deep depression at Salzburg, and none at Sonnblick. On projecting the temperature curve at Görz (shown broken in Fig. 2), we see that the curve for Sonnblick coincides exactly with that at Görz. This is a very significant fact, and shows that the mountain range is a serious drawback to a study of this question from these observations. Taking out all the coincidences, we may say

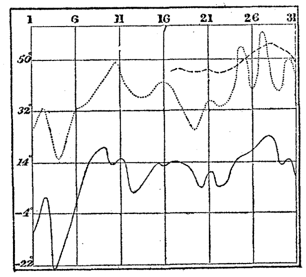
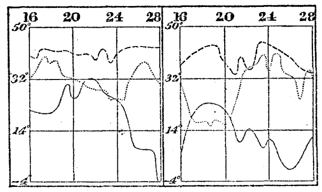


FIG. 2.

Full curve, Sonnblick; dotted, Salzburg; broken, Görz.

there are about 75 per cent fairly satisfactory, though hardly more than 50 per cent, perhaps, as marked as at Mount Washington. I think these discrepancies are due to the causes already set



November, 1889. December, 1889.

FIGS. 3 AND 4.

Full line, Sonnblick; broken, Görz; dotted, Salzburg.

forth, and certainly sink into utter insignificance when compared with the coincidences at Mount Washington. There are two quite interesting discordances in the whole set of curves, and

these are of enough importance to merit a separate discussion. Figs. 3 and 4 exhibit these cases. It will be clearly understood that these are the most serious discordances in the records for more than three years and a half. If it is possible to explain or elucidate these cases, we have practically attained the same result in Austria that we found in this country. During both these periods a high area of great magnitude and persistency settled over this region. We have no similar phenomena in this country as this of high areas (30.7 inches) remaining over one spot for ten days or a fortnight. In Fig. 3 there is no marked fall in temperature at Salzburg; and at Görz, on the south, the curve is almost flat. If we could shift the Sonnblick curve five days later, we would have an almost exact accordance between that and Görz, though I do not insist that that is a necessary view to take. When we look at Fig. 4 we see that there is an exact accordance between the Sonnblick and the Görz curve for a part of the way, and with Salzburg for the rest, so that here all the difficulty disappears at once. We may well believe that in this mountain region there will be great irregularities in the effect of the sun upon the earth and atmosphere. During the prevalence of such high areas the air becomes almost calm and stagnant, and it is an open question whether under these conditions the sun may not have a strong effect at the higher station during the day-time, while the radiation at night would be very much less than at the base; and hence there may be a steady accumulation of heat at the upper station, while at the lower the curve would be nearly horizontal or slightly depressed. It should be noted that while with the progress of ordinary high areas there may be a fall of 20°, and even 40°, at the base, yet in these cases it was very much less, amounting to less than 10° in November.

It is realized that this is merely a beginning in this discussion, and it is hoped that others will take it up, for it is all-important that this whole question be settled. H. A. HAZEN.

Washington, D.C., Aug. 26.

AMONG THE PUBLISHERS.

THE D. Van Nostrand Company have issued, as No. 98 of their Science Series, "Practical Dynamo Building for Amateurs," by Frederick Walker. In this little volume the construction of a dynamo is described in detail so carefully and clearly that any intelligent amateur, skilled in the use of tools, will have no difficulty in producing an efficient machine wound for any desirable output. The book is the first American edition of the work, carefully revised from the second English edition.

—Dr. J. M. Mills of New York has been for several years studying the relation of eye-strain to headaches, etc., among children, and publishes a summary of his findings in an illustrated article in *Babyhood* for September. There appears to be no doubt that cases of short sight, far sight, and irregular sight often go unrecognized until the continued eye-strain results in a chronic headache and lassitude, or even serious nervous disorder. Other articles in the same issue are "Malaria," "Helps for the Fretful Baby," "Occupations and Amusements," and questions and answers upon subjects connected with the diet and clothing of children.

—A work in two quarto volumes, on "The Fossil Insects of North America," by Dr. Samuel H. Scudder of Cambridge, will be issued early in October by Macmillan & Co. The two volumes, of which only one hundred copies will be issued, not only contain, with some slight exceptions, a description of all the species of fossil insects of all American strata so far as known, but practically include the entire body of literature on this topic. The work will be illustrated by about sixty full-page plates, and occasional figures in the text. An English translation by Dr. George McGowan, of Professor Ernest von Meyers's "History of Chemistry," is announced for early publication by the same firm; also (in September) an illustrated work by Dr. R. W. Shufeldt of the Smithsonian Institute, entitled "The Myology of the Raven, a Guide to the Muscular System of Birds."

ATTENTION has been called in various quarters (England, Belgium, France, and Germany) to the remarkably cold weather prevailing of late years, since 1885, in central and western Europe, the yearly averages being constantly under the normal. It now appears from an Algerian record that these years have been warmer than usual in Algeria. It is also shown that there has been no change in the frequency of north and south winds, while in Europe the north-east winds have been increasing in frequency.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED—Index to Vol. VIII. and a copy of No. 205 of SCIENCE. Ten cents will be paid for a copy of either of these if in good condition. Publisher of SCIENCE, 47 Lafayette Place, New York.

TO PRINCIPALS OR COMMITTEES.—Professor of Classics and Sciences, experienced in advertising and building up schools, now employed, desires change. WILLIAM, Roslyn, L. I.

WANTED.—A graduate from the Advanced Course of the Framingham State Normal School desires an assistant's position in a high school. An appointment in New England preferred. Address G., Lock Box 4, Framingham, Mass.

HYBRIDS.—A. M. Suchetet, 10 Rue Alain, Rouen, France, desires to correspond with those possessing hybrids, either living specimens or stuffed, of mammals, birds or other animals.

WANTED.—A Mining Engineer of standing and experience. One having had practical experience in Coal Mining and the manufacture of Coke preferred. Address A., care "SCIENCE."

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of SCIENCE. Other information and a few testimonials can be seen at the Office of SCIENCE.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange Riley's Missouri Reports, either singly or full set, for Proceedings Entomological Society, Philadelphia, vols. 2 to 6 inclusive. Will also exchange Casey's Revision of the *Stenini* of N. A. and Horn's Revision of the *Tenebrionidae*. F. M. Webster, La Fayette, Ind.

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Ancon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.